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CHEMICAL & ENGINEERING NEWS

C&EN

SEPTEMBER 21, 1992

HOW SMALL CHEMICAL FIRMS CAN COPE WITH FEDERAL REGULATIONS PAGE 9

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CHEMISTRY IMAGINED

Chemistry provides theme for art and literature exhibit
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CHEMICAL & ENGINEERING NEWS

C&EN

SEPTEMBER 21, 1992

NEWS OF THE WEEK

■ An extensive yearlong examination of the health of the federal government's research system has been launched by a House committee. Page 4

■ Advisory commission calls for major changes in U.S. patent law, including shift to first-to-file system, to conform with rest of world. Page 5

■ Proposal by France's Pasteur Institute that it receive the bulk of royalties on the AIDS test has been rejected by the Bush Administration. Page 5

■ Average human sperm counts have fallen over past 50 years, perhaps because of exposure to certain chemicals, Danish researchers conclude. Page 5

■ Toxicity problems have been found in a major chlorofluorocarbon substitute, but only at massive doses that aren't likely to be encountered in use. Page 6

COVER: Detail of collage "Steps and Processes" by Vivian Torrence. Photo courtesy of Douglas Drake Gallery, New York City

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BUSINESS

Federal regulations pose problems for most small chemical companies because such firms frequently don't have the necessary resources or the expertise on hand. Page 9

Sales of specialty chemicals in Western Europe are sluggish but strong growth will return, according to a study by market consulting firm Kline & Co. Page 11

GOVERNMENT

The Senate proves to be a bit more generous to federally funded R&D than the House, but funding increase still will be below rate of inflation. Page 13

Department of Defense's efforts at environmental cleanup seem to be paying off, with recent data showing a 54% reduction in hazardous waste output since 1987. Page 15

National Science Foundation begins series of meetings on ways to make the organization more responsive to the scientific community and to the nation's economic needs. Page 16

SCIENCE\TECHNOLOGY

CriSys, a software system for management training, simulates disasters and can be customized for users. Page 21

Research efforts for direct conversion of coal to fuel oils appear to have been redirected toward using conventional refineries for production of finished products. Page 23

Methods for reducing carbon dioxide emissions are appraised, as worldwide efforts to mitigate environmental effects of these emissions continue. Page 24

EDUCATION

Push to restructure precollege science education gets more emphasis at ACS presidential plenary session from speakers who describe ways to combat the education crisis. Page 27

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Local sections judged to have had the best National Chemistry Week programs in 1991 receive Phoenix Awards. Page 31

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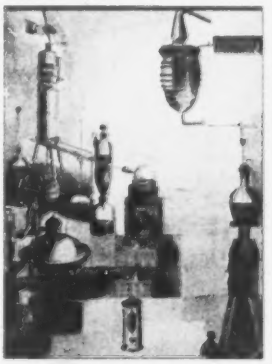

"Chemistry Imagined," a traveling exhibition in which chemistry provides the theme for art and literature, will be displayed at the National Academy of Sciences through Jan. 6, 1993. Page 18

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LETTERS

Alternatives to open-book exams

In response to Morris Feller's recommendation that examinations be "open-book" (C&EN, Aug. 17, page 5), teachers believe that examinations serve at least two, and occasionally three functions: 1. Most important—scheduled examinations induce students to study or review the course material. 2. The results of examinations provide teachers with assessments of the students' ability to utilize the course material (hence the basis for grades), and some feedback as to how well the information was presented. 3. For the earnest students, the results of examinations provide incentives for remedial study, and indicators of the relative significance of the various parts of the course, as evaluated by the instructor.

Large classes (200–400 students) force instructors to use some form of machine (or template) grading, and consequently a multiple-choice format. This is an abomination, always decried, but most teachers are convinced that this type of record keeping is unavoidable. Given practical time limitations, multiple-choice and open-book examinations are incompatible. But there are serious problems with open-book examinations, even for moderate-sized classes (25–50 students). For many students, the announcement of an open-book examination relieves the pressure to review the course material; reliance is placed on the hope of finding the proper equation, the essential concept, or sample problems in the textbook. Then, during the examination, much time is spent in leafing pages, searching for the needed material, replacing thinking with searching. Students who bring three or more books to the exam generally garner the lowest grades. The benefit of function one is minimized. Open-book examinations are recommended for advanced students who are given days to complete significant assignments, and to utilize as needed the available literature.

For moderate-sized undergraduate classes, there is a practical alternative. Suggest that students may bring to the examination all of their personal handwritten notes, as well as hand-held calculators. This has the advantage that each person must prepare notes in suitable form for rapid reference. Since the transcription of the lecture and text material is practically limited, each student must select that which he or she considers most pertinent; no one can afford to bypass the review. Reliance on rote memory of equations, definitions, and statements of general principles is thus eliminated. Clearly, the instructor must then devote more effort to devising examinations that exclude questions that require mere substitution in set formulas, and to focus on thoughtful applications. Use of the so-called ponies should be encouraged, but photocopied material should not be allowed.

S. H. Bauer
Cornell University
Ithaca, N.Y.

I agree with Morris Feller's letter regarding open-book exams, to the extent that in the real world we have available the reference books that we need.

But theoretical problem-solving ability is not the same as appropriate situational response. How often I have been grateful for the at-my-fingertips, think-on-my-feet understanding and back-of-the-envelope ability to marshall information initiated at Pomona while I was learning how to pass weekly tests given by Conway Pierce, Nelson (Nellie) Smith, and Corwin Hansch! Regurgitating facts wasn't enough: We had to know principles to understand the facts.

Currently, in presenting to our younger staff members the basic industrial hygiene (including some chemistry) needed by insurance company safety engineers, I have often been amazed at their ability to remember, and perplexed by their inability to evaluate information. It's as if all facts had the same weight and importance.

A combination of Feller's approach, and what has been successful for me, might be effective: open-book tests with so many questions of such difficulty that they could only be passed in the allotted time by students who had committed their energy to master the subject.

Richard Persoff
Senior Technical Consultant
ITT Hartford
San Francisco

Correction

- Aug. 31, page 58: Albert I. Meyers' name was misspelled.

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European specialty chemicals sales sluggish

Sales of specialty chemicals in Western Europe this year are projected to reach about $63 billion, according to an analysis by Kline & Co., the Fairfield, N.J.-based market consulting firm. This is up slightly from $62 billion in 1991 and from $58.7 billion in 1990, according to William T. Eveleth, project manager for the firm's major study, the "Kline Guide to the Western European Chemical Industry," which contains the analysis of specialties.

According to the study—which projects sales for 1992 and profitability potential for 50 specialty chemical categories—industrial coatings, agricultural chemicals, and industrial and institutional cleaning products are the largest categories of specialty chemicals, together accounting for more than one third of the total specialty sales. However, the greatest opportunities, in terms of sales growth and profitability, lie in such diverse product groups as diagnostic aids, flavors and fragrances, and water management chemicals.

The definition of a specialty chemical has always been a problem within the chemical industry, with some analysts opting for the term high value added. However, although this consideration enters into Kline's criteria, the firm defines specialties as "differentiated products sold on the basis of the functions they perform in use, as distinguished from commodities and fine chemicals, which are composition products, sold for their chemical content."

Although sales of specialty chemicals in Western Europe will grow at less than 2% in 1992 because of the recession in Europe, during the next four to five years they likely will return to more historic growth rates of 4 to 5% per year, Eveleth tells C&EN.

Of the chemicals with high potential for growth, Eveleth says, "We are projecting growth for diagnostic aids at 6% [per year] over the next five years. Advances in diagnostics technology, particularly in antibody and enzyme tests, coupled with the convenience and cost savings offered by kits, are the main driving forces for this strong growth." Diagnostic aids are likely to register 1992 sales of about $2.72 billion.

Use of flavors and fragrances, with projected 1992 sales of almost $3.67 billion, has grown strongly in past decades, according to Eveleth, and is poised for continued favorable growth. Flavors are benefiting from increased consumption of prepared foods, whereas fragrance compounds are experiencing higher demand through exports to Asia and South America, where consumption of cosmetics and toiletries is increasing. Eveleth says: "Growth in disposable income in developing nations is fueling demand for toiletries and other consumer goods. European producers of these products and their raw materials will benefit from this trend."

The other major specialty area with strong growth potential is water management chemicals, including such specialties as corrosion and scale inhibitors, flocculents, and biocides. Here demand growth will be in step with increasing environmental regulations and greater emphasis on higher value-added products and services.

William Storck

Most specialties are of average profitability, but of the others, highs outnumber lows

Category	$ Millions, 1992	Apparent profitability
Adhesives[a]	$ 1,165	High
Agricultural chemicals[b]	7,185	High
Antioxidants	465	Average
Biocides	480	Average
Catalysts[a]	1,960	Average
Chelates[c]	215	Average
Coal & fuel additives	175	High
Construction chemicals	2,150	High
Corrosion inhibitors	210	High
Cosmetic additives	1,615	Average
Defoamers	130	High
Diagnostic aids	2,720	High
Elastomers	2,390	High
Electronic chemicals	1,870	Average
Enzymes, industrial	330	Average
Flame retardants	375	Average
Flavors & fragrances	3,665	High
Food additives	2,770	Average
Foundry chemicals	335	Low
Fuel additives[d]	100	High
Industrial & institutional cleaners	5,240	High
Industrial coatings	10,120	Average
Ion-exchange resins	90	Average
Laboratory chemicals	1,070	Average
Lubricant & functional fluid additives	1,160	High
Lubricants & functional fluids (synthetic)	490	High
Metal plating & finishing chemicals[a]	$ 510	Average
Oil field chemicals[a]	375	Low
Paint additives[a]	430	Average
Paper additives	1,975	Average
Photographic chemicals	600	High
Pigments[a]	1,450	Average
Plasticizers	1,420	Average
Plastics additives	3,820	Average
Printing chemicals	215	Average
Printing inks	3,105	Average
Refinery & pipeline chemicals	175	High
Rubber processing chemicals	410	Average
Sealants & caulks	1,035	Average
Specialty polymers	3,430	Average
Specialty surfactants	945	Average
Textile specialties	725	Average
Thickeners[e]	924	Average
UV absorbers	135	Average
Water management chemicals[f]	530	High
GRAND TOTAL	$70,685	
LESS DOUBLE COUNTING	$ 7,935	
NET TOTAL	$62,750	

a Low-volume, high-priced types only. b Excludes fertilizer. c Nitriloacid types. d Excludes antiknocks and octane enhancers. e Excludes starch. f Includes specialty materials.
Source: Kline & Co.

Senate Slightly More Generous than House for 1993 R&D Funding

■ ***Unlike House, Senate would fund all big science projects; most activities wouldn't even keep up with inflation***

Janice R. Long, C&EN Washington

The Senate has just about completed its work on the appropriations bills that will fund the government civilian research and development activities in fiscal 1993, which begins Oct. 1. The full Senate has made no major changes, and very few minor ones, in the levels of support recommended by the Appropriations Committee. It has agreed to fund all of the so-called big science projects. Overall, it has provided slightly more money for R&D activities than did the House, but not enough more to allow the majority of those activities even to keep up with the current low rate of inflation.

Agencies that last year were looking at budget increases of anywhere from 6 to 27% will have to learn to live with much smaller increases in fiscal 1993. For example, the National Institutes of Health (NIH) saw its overall budget rise 10% to $8.1 billion in fiscal 1992. The Senate Appropriations Committee has allowed an increase of just 3% to $8.4 billion for the coming fiscal year, the same percentage increase set by the House. This is the first time in years that both branches of Congress haven't upped an Administration's budget request. The Administration was seeking a 5% increase for NIH for fiscal 1993.

Missing from the NIH appropriations bill this year are any references to abuses, such as charging unallowed expenditures under the independent cost recovery system for research grants, which so exercised the Appropriations Committee last year. Also missing are provisions prohibiting the agency from spending some of its funds until the last day of the fiscal year. This year, NIH had been told to hold back 6% of its budget, or $563 million, for expenditure on Sept. 30, which means the money won't actually be distributed until fiscal 1993. And the Administration has asked that spending of $619 million worth of NIH's fiscal 1993 budget be similarly delayed.

However, the House Appropriations Committee refused to go along. It called the request a "practice, which was started by the Administration in its 1992 budget request, an accounting gimmick that has the effect of making future budget decisions even more difficult than they already are under the spending caps agreed to in the Budget Enforcement Act of 1990." The Senate committee followed suit.

The Senate also approved a 3% increase in funding to $5.0 billion for the Department of Energy's energy R&D programs. That's good news in comparison to the House's decision to cut overall funding for those same programs 8% to $4.5 billion. And the Senate reversed the House's decision to kill the Superconducting Super Collider.

However, the good news doesn't apply to basic energy sciences, which includes DOE's research programs in the chemical and materials sciences. Whereas the House froze funding for those programs at current levels, the Senate provided an increase of only 1% to $775 million. Under the Senate bill, funding for DOE weapons R&D activities would rise 6% to $1.5 billion, compared with the House's action that froze funding at $1.4 billion.

Compared with NIH and DOE, the National Science Foundation (NSF) looks like a winner in the 1993 budget cycle. The House allowed it a 4% increase to $2.5 billion and the Senate a 7% increase to $2.6 billion. But most of the Senate increase is slated for education and human resources as well as instrumentation and facilities, plus a new $55 million defense conversion traineeships program. This program, according to the committee report, will provide a stipend and cost-of-education allowance to academic institutions capable of providing effective programs that will aid the estimated 127,000 defense engineers who may lose their jobs during the next few years as they make the transition to work in the civilian R&D enterprise.

Monies for NSF's research and related activities account were essentially frozen by the House at the current funding level of $1.9 billion, but under the Senate bill they actually decrease by $13 million. The House Appropriations Committee said that "in view of the very difficult domestic discretionary budget climate, which is reflected in this recommendation, [we are] concerned that large science facility projects will increasingly erode funding for individual investigator grants. Therefore, the committee directs the foundation and the National Science Board [NSB] to reconsider the priority, structure, and funding options relative to the Laser Interferometer Gravitational Wave Observatory; the eight-meter (GEMINI) telescope project; a research aircraft for the National Center for Atmospheric Research (NCAR); and a new Arctic research vessel." The committee directed NSF not to fund the projects until the NSB review is completed.

The Senate Appropriations Committee took a different tack—eliminating funding for NCAR's aircraft and scaling back funding for the other projects. And the committee will not require that the NSB report be completed before funding. However, the Senate report on NSF's appropriations bill is awash in directives to the foundation that tell it in minute detail how and where it should spend its funds, and redirect its activities, and requiring re-

Senate gives big boost to national standards institute

$ Millions	1993 Senate appropriations	1993 House appropriations	1993 Administration request	1992	% difference Senate/House	% change 1992–93 (Senate)
Health & Human Services	$ 9,953.6[a]	$10,057.4	$10,219.4	$ 9,483.3	–1%	2%
National Institutes	8,365.3	8,354.9	9,794.9	8,101.2	0	3
Cancer	2,010.4	1,998.6	2,010.4	1,951.5	1	3
Heart, Lung & Blood	1,228.4	1,228.4	1,245.4	1,191.5	0	3
Allergy & Infectious Diseases	989.1	990.1	1,010.8	960.9	0	3
General Medical Sciences	833.0	842.2	862.1	815.1	–1	2
Diabetes, Digestive & Kidney Diseases	688.6	688.6	699.8	662.7	0	4
Neurological Disorders & Stroke	607.1	605.1	615.2	581.8	0	4
Child Health & Human Development	534.1	534.1	545.2	519.7	0	3
Aging	405.2	402.2	407.3	383.6	1	6
Eye	279.1	279.1	285.1	270.3	0	3
Environmental Health Sciences	255.1	255.1	261.5	252.0	0	1
Arthritis & Musculoskeletal & Skin Diseases	214.6	214.6	214.9	203.9	0	1
Dental Research	163.3	163.3	166.7	159.1	0	3
Deafness & Other Communication Disorders	157.3	153.5	157.3	149.1	2	6
Alcohol, Drug Abuse & Mental Health Administration	1,165.5	1,280.9	1,309.1	1,274.2	–9	–9
National Center for Research Resources	315.6	314.4	318.2	314.6	0	0
National Center for Human Genome Research	107.2	107.2	110.4	104.9	0	2
NASA R&D	7,117.1	6,670.7	7,731.4	6,409.7	7	11
Space station[b]	2,100.0	1,750.0	2,238.9	1,986.8	20	6
Energy	6,529.6	5,932.5	6,632.6	6,307.9	10	4
Energy R&D	5,008.5	4,500.9	5,168.4	4,875.3	11	3
General science & research	1,460.8	998.9	1,652.7	1,472.5	46	–1
Superconducting Super Collider[b]	550.0	33.7	650.0	483.7	153	14
Basic energy sciences	774.9	764.9	813.9	764.7	1	1
Environmental restoration & waste management	709.7	709.7	707.0	602.5	0	18
Fossil	422.7	412.6	311.3	452.3	2	–7
Environmental R&D	363.7	356.7	384.7	353.3	2	3
Fusion	335.0	339.7	359.7	337.1	–3	–1
Nuclear	296.5	304.3	310.3	336.7	–3	–12
Conservation	318.0	311.4	326.1	260.0	2	22
Solar, other renewables	271.5	247.0	247.0	241.7	10	12
University & science education programs	55.7	55.7	55.7	54.5	0	2
Weapons R&D	1,521.1	1,431.6	1,464.2	1,432.6	6	6
NSF	2,618.0	2,541.0	2,888.0	2,449.0	3	7
Research & related activities	1,859.0	1,879.0	2,211.5	1,872.0	–1	–1
Education & human resources	510.0	465.0	479.5	465.0	10	10
Antarctic program	143.0	163.0	163.0	78.0	–12	83
Defense conversion engineering traineeships	55.0	0	0	0	100	100
Instrumentation & facilities	50.0	33.0	33.0	33.0	51	51
Critical Technologies Institute	1.0	1.0	1.0	1.0	0	0
USDA	1,330.8	1,328.1	1,300.1	1,396.7	0	–6
Agricultural Research Service	684.1	695.4	714.0	711.5	–2	–4
Cooperative State Research Service	468.0	446.0	416.0	504.7	5	–7
Forest research	178.7	186.7	170.1	180.5	–4	–1
Commerce	794.2	447.1	504.4	459.7	78	73
National Institute of Standards & Technology	597.0	250.9	310.7	246.7	138	142
Oceanic & atmospheric research	197.2	196.2	193.7	213.0	1	–7
EPA extramural R&D	323.0	338.5	338.5	320.9	–5	–1
TOTAL	$28,666.3	$27,315.3	$29,614.4	$27,138.8	5%	6%

Note: All numbers are estimated. a Amounts recommended by Senate Appropriations Committee. b Funds included in total.

ports to Congress on a wide array of subjects. Many of these directives seem to be aimed at increasing NSF's ties with industry and focusing its activities on "technologies deemed to be critical to the nation's competitiveness."

That emphasis on competitiveness is behind the astonishing 142% Senate-approved increase to $597 million in funding for the National Institute of Standards & Technology (NIST). The House held NIST to a much more modest 2% increase to $251 million. Behind the surge in funding is a new account that the Senate added to the NIST budget—defense economic conversion, research, and technology—and funded at $109 million. According to the Appropriations Committee report, the "initiative is intended to capitalize on the agency's experience and charter to stimulate technological innovation by facilitating the conversions and transition of American industry to non-defense manufacturing." The vast majority of the funds—$100 million—are to be used in NIST's external grant programs: the advanced technology program, manufacturing technology centers, and the state technology extension programs.

The Senate also provided $202 million for NIST's central scientific and technical research and services programs, an increase of 10% over current levels. That includes an increase of $700,000 for chemical science and technology. Funding for NIST's industry technology services is up 35% to $86.1 million.

Funding for the Environmental Protection Agency's extramural R&D programs would decline 1% to $323 million under the Senate appropriations bill, but would rise 5% to $338.5 million under the House bill. But that's not the only difference between the two bills. The Senate Appropriations Committee deleted from that account $19 million earmarked by the House for 16 research projects, but added back $9.5 million for nine of its own priority projects.

Final budget numbers for all of these programs must still be ironed out in House-Senate conferences, and it may turn out that the Senate's new defense conversion program won't emerge unscathed. In fact, it may disappear entirely. However, funding for most research programs probably will come in somewhere between the House and Senate figures. □